

Claims

1. A method of aligning display substrates comprising an array of pixels with component substrates comprising an array of optical components; the method  
5 comprising:

forming a display motherglass with an array of panels each comprising an array of visible pixels sufficient for a single display substrate and with, in respect of each panel, a first alignment feature arranged outside the array of visible pixels and having a surface relief aligned with the array of pixels of the respective panel;

- 10 dividing the display motherglass into display substrates each comprising an array of pixels and a first alignment feature;

forming component substrates each with an array of optical components and a second alignment feature having a surface relief aligned with the array of optical components, the surface relief of the second alignment feature being shaped to register  
15 with the surface relief of the first alignment feature; and

attaching the display substrates to respective component substrates with the first and second alignment features in registration with each other.

2. A method according to claim 1, wherein the step of forming the display  
20 motherglass comprises forming the display motherglass with an array of panels each comprising an array of pixels sufficient for a single display substrate and attaching the first alignment features to the display motherglass.

3. A method according to claim 2, wherein the first alignment feature has an optical  
25 function and the step of attaching the first alignment features to the display motherglass includes aligning the surface relief of the first alignment features with the array of pixels using an optical alignment technique.

4. A method according to any one of the preceding claims, wherein the step of  
30 forming component substrates comprises

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forming a component motherglass with an array of panels each comprising an array of optical components sufficient for a single component substrate and with, in respect of each panel, a second alignment feature aligned with the array of optical components, and

5       dividing the component motherglass into display substrates each comprising an array of optical components and a second alignment feature.

5.       A method according to any one of the preceding claims, wherein  
the second alignment feature is formed in a common layer with part of the  
10   structure of the optical component, and

the step of forming component substrates comprises forming the common layer with both the second alignment feature and said part of the structure of the optical component.

15   6.       A method according to any one of the preceding claims, wherein the surface relief of the second alignment feature repeats in the same direction in which the optical components repeat at a pitch substantially equal to the pitch of the optical components.

7.       A method according to claim 6, wherein the first alignment feature has the same  
20   optical function as the optical component.

8.       A method according to any one of claims 1 to 5, wherein the surface relief of the second alignment feature repeats in the same direction in which the optical components repeat at a pitch substantially equal to an integer multiple of the pitch of the optical  
25   components.

9.       A method according to any one of the preceding claims, wherein the surface relief of the first alignment feature repeats in the same direction in which the optical components repeat at a pitch substantially equal to the pitch of the optical components.

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10. A method according to any one of claims 1 to 8, wherein the surface relief of the first alignment feature repeats in the same direction in which the optical components repeat at a pitch substantially equal to an integer multiple of the pitch of the optical components.

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11. A method according to any one of the preceding claims, wherein the optical components have a focal length and the first alignment feature has a height above the array of pixels substantially equal to the focal length of the optical components.

10 12. A method according to any one of the preceding claims, wherein the first alignment feature comprises a micro-structure layer on a support layer.

13. A method according to any one of the preceding claims, wherein the surface reliefs of the first and second alignment features have inverse shapes.

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14. A method according to any one of the preceding claims, wherein the display substrate comprises an active matrix substrate for a display panel and a counter substrate.

20 15. A method according to any one of the preceding claims, wherein the optical components are lenses.

16. A display apparatus comprising a display substrate comprising an array of visible pixels attached to a component substrate comprising an array of optical components, wherein the display substrate has a first alignment feature arranged outside the array of visible pixels and, aligned with the array of visible pixels, the component substrate has a second alignment feature aligned with the array of optical components, and the first and second alignment features have respective surface reliefs in registration with each other.

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17. A display apparatus according to claim 16, wherein the first alignment feature is attached to the display substrate.
18. A display apparatus according to claim 17, wherein the first alignment feature  
5 has an optical function.
19. A display apparatus according to claim 18, wherein the optical function of the first alignment feature is the same as the optical function of the optical components.
- 10 20. A display apparatus according to any one of claims 16 to 19, wherein the second alignment feature is formed in a common layer with part of the structure of the optical component.
- 15 21. A display apparatus according to any one of claims 16 to 20, wherein the surface relief of the second alignment feature repeats in the same direction in which the optical components repeat at a pitch substantially equal to the pitch of the optical components.
- 20 22. A display apparatus according to any one of claims 16 to 20, wherein the surface relief of the second alignment feature repeats in the same direction in which the optical components repeat at a pitch substantially equal to an integer multiple of the pitch of the optical components.
- 25 23. A display apparatus according to any one of claims 16 to 22, wherein the surface relief of the first alignment feature repeats in the same direction in which the optical components repeat at a pitch substantially equal to the pitch of the optical components.
- 30 24. A display apparatus according to any one of claims 16 to 22, wherein the surface relief of the first alignment feature repeats in the same direction in which the optical components repeat at a pitch substantially equal to an integer multiple of the pitch of the optical components.

25. A display apparatus according to any one of claims 16 to 24, wherein the optical components have a focal length and the first alignment feature has a height above the array of pixels substantially equal to the focal length of the optical components.
- 5 26. A display apparatus according to any one of claims 16 to 25, wherein the first alignment feature comprises a micro-structure layer on a support layer.
27. A display apparatus according to any one of claims 16 to 26, wherein the surface reliefs of the first and second alignment features have inverse shapes.
- 10 28. A display apparatus according to any one of claims 16 to 27, wherein the display substrate comprises an active matrix substrate for a display panel and a counter substrate.
- 15 29. A display apparatus according to any one of claims 16 to 28, wherein the optical components are lenses.
30. A display apparatus according to any one of claims 16 to 29, wherein the display substrate has been formed by division from a motherglass.
- 20 31. A display apparatus according to any one of claims 16 to 30, wherein the component substrate has been formed by division from a motherglass.
32. A display substrate comprising an array of pixels for attachment to a component substrate comprising an array of optical components, wherein the display substrate has a first alignment feature having a surface relief arranged outside the array of visible pixels and aligned with the array of pixels.
- 25 33. A display substrate according to claim 31, wherein the first alignment feature is attached to the display substrate.
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34. A display substrate according to claim 32, wherein the first alignment feature has an optical function.

35. A display substrate according to any one of claims 32 to 34, wherein the first alignment feature comprises a micro-structure layer on a support layer.

36. A display substrate according to any one of claims 32 to 35, wherein the display substrate comprises an active matrix substrate for a display panel and a counter substrate.

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37. A display substrate according to any one of claims 32 to 36, wherein the display substrate has been formed by division from a motherglass.

38. A component substrate comprising an array of optical components for attachment to a display substrate comprising an array of visible pixels and a second alignment feature arranged outside the array of optical features to be aligned with the array of visible pixels of the display substrate and having a surface relief aligned with the array of optical components.

39. A component substrate according to claim 38, wherein the second alignment feature is formed in a common layer with part of the structure of the optical component.

40. A component substrate according claim 38 or 39, wherein the surface relief of the second alignment feature repeats in the same direction in which the optical components repeat at a pitch substantially equal to the pitch of the optical components.

41. A component substrate according claim 38 or 39, wherein the surface relief of the second alignment feature repeats in the same direction in which the optical components repeat at a pitch substantially equal to an integer multiple of the pitch of the optical components.

42. A component substrate according to any one of claims 38 to 41, wherein the optical components are lenses.

43. A component substrate according to any one of claims 38 to 42, wherein the component substrate has been formed by division from a motherglass.

44. A display motherglass comprising an array of panels each comprising an array of visible pixels sufficient for a single display substrate and with, in respect of each panel, a first alignment feature having a surface relief arranged outside the array of visible pixels and aligned with the array of visible pixels.

45. A display motherglass according to claim 44, wherein the first alignment feature is attached to the display motherglass.

46. A display motherglass according to claim 45, wherein the first alignment feature has an optical function.

47. A display motherglass according to any one of claims 44 to 46, wherein the first alignment feature comprises a micro-structure layer on a support layer.

48. A display motherglass according to any one of claims 44 to 47, wherein the display motherglass comprises an active matrix substrate for a display panel and a counter substrate.

49. A component motherglass comprising an array of panels each comprising an array of optical components sufficient for a single component substrate for attachment to a display substrate comprising an array of visible pixels, and, in respect of each panel, a second alignment feature arranged outside the array of optical features to be aligned with the array of visible pixels of the display substrate and aligned with the array of optical components.

50. A component motherglass according to claim 49, wherein the second alignment feature is formed in a common layer with part of the structure of the optical component.

51. A component motherglass according claim 49 or 50, wherein the surface relief  
5 of the second alignment feature repeats in the same direction in which the optical components repeat at a pitch substantially equal to the pitch of the optical components.

52. A component motherglass according claim 49 or 50, wherein the surface relief  
10 of the second alignment feature repeats in the same direction in which the optical components repeat at a pitch substantially equal to an integer multiple of the pitch of the optical components.

53. A component motherglass according to any one of claims 49 to 52, wherein the optical components are lenses.

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